

Achievement Standard

Subject Reference Mathematics and Statistics 3.5

Title Apply the algebra of complex numbers in solving problems

Level 3 **Credits** 5 **Assessment** External

Subfield Mathematics

Domain Algebra

Status Registered **Status date** 4 December 2012

Planned review date 31 December 2020 **Date version published** 17 November 2016

This achievement standard involves applying the algebra of complex number in solving problems.

Achievement Criteria

Achievement	Achievement with Merit	Achievement with Excellence
<ul style="list-style-type: none"> Apply the algebra of complex numbers in solving problems. 	<ul style="list-style-type: none"> Apply the algebra of complex numbers, using relational thinking, in solving problems. 	<ul style="list-style-type: none"> Apply the algebra of complex numbers, using extended abstract thinking, in solving problems.

Explanatory Notes

- This achievement standard is derived from Level 8 of *The New Zealand Curriculum*, Learning Media, Ministry of Education, 2007; and is related to the achievement objectives:
 - Manipulate complex numbers and present them graphically
 - Form and use polynomial, and other non-linear equations
 in the Mathematics strand of the Mathematics and Statistics Learning Area. It is also related to the material in the *Teaching and Learning Guide for Mathematics and Statistics*, Ministry of Education, 2012, at <http://seniorsecondary.tki.org.nz/>.

This standard is also derived from *Te Marautanga o Aotearoa*. For details of the *Marautanga* achievement objectives to which this standard relates, see the [Māori version](#) of the standard.

- 2 Apply the algebra of complex numbers in solving problems involves:
- selecting and using methods
 - demonstrating knowledge of concepts and terms
 - communicating using appropriate representations.

Relational thinking involves one or more of:

- selecting and carrying out a logical sequence of steps
- connecting different concepts or representations
- demonstrating understanding of concepts
- forming and using a model;

and also relating findings to a context, or communicating thinking using appropriate mathematical statements.

Extended abstract thinking involves one or more of:

- devising a strategy to investigate or solve a problem
- identifying relevant concepts in context
- developing a chain of logical reasoning, or proof
- forming a generalisation;

and also using correct mathematical statements, or communicating mathematical insight.

- 3 Problems are situations that provide opportunities to apply knowledge or understanding of mathematical concepts and methods. Situations will be set in real-life or mathematical contexts.
- 4 Methods are selected from those related to:
- quadratic and cubic equations with complex roots
 - Argand diagrams
 - polar and rectangular forms
 - manipulation of surds
 - manipulation of complex numbers
 - loci
 - De Moivre's theorem
 - equations of the form $z^n = r \operatorname{cis} \theta$, or $z^n = a + b i$ where a, b are real and n is a positive integer.

1 Assessment Specifications for this achievement standard can be accessed through the Mathematics and Statistics Resources page found at <http://www.nzqa.govt.nz/qualifications-standards/qualifications/ncea/subjects/>.

Replacement Information

This achievement standard replaced unit standard 5267 and AS90638.

Quality Assurance

- 1 Providers and Industry Training Organisations must have been granted consent to assess by NZQA before they can register credits from assessment against achievement standards.

- 2 Organisations with consent to assess and Industry Training Organisations assessing against achievement standards must engage with the moderation system that applies to those achievement standards.

Consent and Moderation Requirements (CMR) reference

0233

Paerewa Paetae

Aronga	Pāngarau 3.5			
Ingoa	Te whakamahi tikanga taurangi o ngā tau hiato hei whakaoti rapanga			
Kaupae	3	Whiwhinga	5	Aromatawai Ā-waho
Marau akoranga	Te Marautanga o Aotearoa			
Kokonga akoranga	Pāngarau			
Mana rēhita	Kua rēhitatia	Te rā i mana ai	4 Hakihea 2012	
Te rā e arotakengia ai	31 Hakihea 2020	Te rā i puta ai	17 Whiringa-ā-rangi 2016	

Te Hononga ki te Marautanga

I ahu mai tēnei paerewa paetae i te Taumata 8 o *Te Marautanga o Aotearoa*, i whakaputaina e Te Pou Taki Kōrero i te tau 2008.

Whāinga Paetae

Te Taurangi me te Tuanaki, Te Whārite me te Kīanga

9 *Ka tuhi, ka whakamahi whārite pākoki, whārite pūrau, me ētahi atu whārite rārangi-kore.*

10 *Ka rāwekeweke tau hiato hei whakaoti whārite, ā, ka whakaatu anō ki te kauwhata.*

E hono ana ki te Papa Whakaako mō te Pāngarau kei te pae tukutuku nei:

<http://tmoa.tki.org.nz/Te-Marautanga-o-Aotearoa/Taumata-Matauranga-a-Motu-Ka-Taea>

Te Hononga ki *The New Zealand Curriculum* (NZC)

I ahu mai hoki tēnei paerewa paetae i *The New Zealand Curriculum*. Mō ngā kōrero e pā ana ki ngā whāinga paetae o te NZC e hāngai ana ki tēnei paerewa, tirohia te [putanga reo Pākehā](#) o te paerewa.

Te Hononga ki ngā Paearu Aromatawai

Arā ngā Paearu Aromatawai mō tēnei paerewa paetae, kei te:

<http://tmoa.tki.org.nz/Te-Marautanga-o-Aotearoa/Taumata-Matauranga-a-Motu-Ka-Taea>

Paerewa Paetae

<p>Paetae Te whakamahi tikanga taurangi o ngā tau hiato hei whakaoti rapanga.</p>	<p>Hei tohu i te paetae:</p> <ul style="list-style-type: none"> • Ka whiriwhiri, ka whakamahi i ētahi tikanga whānui hei whakaoti rapanga. • Ka whakaatu mōhiotanga ki ngā huatau me ngā kupu e hāngai ana hei whakaoti rapanga. • Ka tūhono i ētahi huatau rerekē. • Ka whakamārama i ngā otinga mēnā kotahi, e rua rānei ngā mahi o roto i te tikanga i whakamahia ai.
<p>Kaiaka He kaiaka te whakamahi tikanga taurangi o ngā tau hiato hei whakaoti rapanga.</p>	<p>Hei tohu i te kaiaka:</p> <ul style="list-style-type: none"> • Ko te whakaaro tūhonohono te mea nui. Arā, kia kotahi, nui ake rānei o ēnei: <ul style="list-style-type: none"> – ka whiriwhiri, ka whakatutuki raupapatanga mahi arorau hei whakaoti rapanga. – ka tūhono i ētahi huatau rerekē, i ētahi whakaahuahanga rerekē rānei hei whakaoti rapanga. – ka whakaatu māramatanga ki ngā huatau e hāngai ana – ka hanga, ka whakamahi tauira. • Ka tūhono i ngā otinga ki tētahi horopaki, ka whakamahi rānei i ngā kīanga pāngarau hei whakawhitiwhiti whakaaro.
<p>Kairangi He kairangi te whakamahi tikanga taurangi o ngā tau hiato hei whakaoti rapanga.</p>	<p>Hei tohu i te kairangi:</p> <ul style="list-style-type: none"> • Ko te whakaaro waitara te mea nui. Arā, kia kotahi, nui ake rānei o ēnei: <ul style="list-style-type: none"> – ka waihanga rautaki hei tūhura, hei whakaoti rānei i tētahi rapanga. – ka tautohu i ngā huatau e hāngai ana ki te horopaki. – ka whakaputa i tētahi raupapatanga whakaaro arorau, i tētahi hāponotanga rānei. – ka hanga whakawhānuitanga. • Ka whakamahi i ngā kīanga pāngarau tika hei whakawhitiwhiti i te aroā pāngarau.

Kōrero Āpiti

1 E whai ake nei ngā whakamārama o ngā tino kupu, kīanga rānei:

rapanga	Ko ngā āhukatanga o ia rā, ngā āhukatanga pāngarau rānei ka whai wāhi mai te whakamahinga o te mātauranga pāngarau, o ngā huatau pāngarau, o ngā tikanga pāngarau rānei.
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2 Kia taunga te ākongā ki ngā tikanga taurangi o ngā tau hiato:

- i. ngā whārite pūrua, ngā whārite pūtoru me ngā otinga tau hiato
- ii. ngā kauwhata tau hiato, ngā taunga tau hiato (Argand diagrams)
- iii. ngā tau hiato hei taunga ahuroa: ko te roanga o te tapa roa rawa o te tapatoru hāngai, ko te rahi o te tau hiato; ko te rahi o te huringa koki mai i te tuaka huapae ki te pere; ngā tau hiato hei taunga kauwhata rānei

- iv. te rāwekeweke i te hanumitanga o ngā tau oti me ngā tau pūtake
- v. te rāwekeweke i ngā tau hiato
- vi. ngā huanui
- vii. te ariā a De Moivre
- viii. ngā whārite $z^n = r \operatorname{cis}(\theta)$, ngā whārite $z^n = a + bi$, he tau oti te a me te b , he tau tōpū tōrunga te n .

Kuputaka:

aroā pāngarau	mathematical insight
kīanga pāngarau	mathematical statement
pere	argument
rahi o te tau hiato	modulus
tau hiato	complex number
taunga kauwhata	rectangular coordinate
taunga ahuroa	polar coordinate
whakaaro arorau	logical thinking, reasoning
whakaaro tūhonohono	relational thinking
whakaaro waitara	abstract thinking

He Kōrero mō te Whakakapi

Koinei hei whakakapi i te paerewa 5267 me te paerewa paetae 90638.

Tātari Kounga

- 1 Me mātua whakamana ngā Kaituku Akoranga me ngā Whakahaere Whakangungu Ahumahi e te Mana Tohu Mātauranga o Aotearoa ka rēhita ai i ngā hua ka puta mai i ngā aromatawai ki ngā paerewa paetae.
- 2 Ko ngā Kaituku Akoranga me ngā Whakahaere Whakangungu Ahumahi kua mana, ā, e aromatawai ana i ā rātou hōtaka ki ngā paerewa paetae, me uru rātou ki ngā pūnaha whakaōrite e tika ana mō aua paerewa paetae.

Ko te tohutoro ki te Mahere Whakamana, Whakaōritenga hoki

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